

# Subproject Schedules

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**Director's Review of BTeV Schedule**

**May 27, 2004**

# Overview – BTeV WBS

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- **WBS 3.0** – C0 Outfitting
- **WBS 2.0** – **Interaction Region**
- **WBS 1.0** – BTeV Detector
  - WBS 1.1 – Analysis magnet, Beampipes, Toroids
  - WBS 1.2 – **Pixel Detector**
  - WBS 1.3 – RICH
  - WBS 1.4 – **EMCAL**
  - WBS 1.5 – Muon System
  - WBS 1.6 – Straw Tracker
  - WBS 1.7 – Silicon Microstrip Tracker
  - WBS 1.8 – **Trigger**
  - WBS 1.9 – **Data Acquisition**
  - WBS 1.10 – **I & I**

## Summary of changes since last review

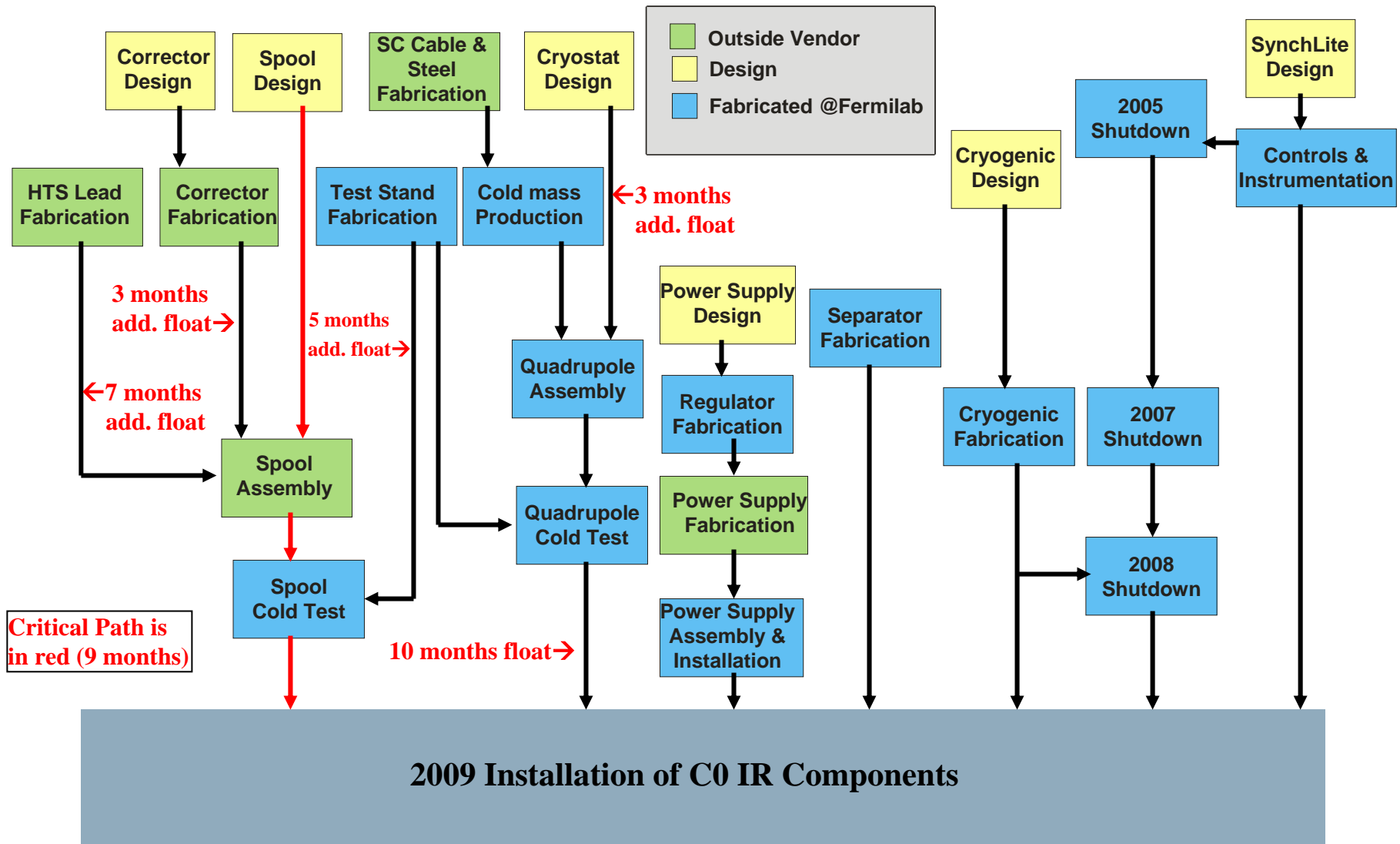
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- Staging of Detector
- Uniform method of calculating schedule contingency
  - Separation of construction and installation phases
    - “Ready by” date from construction phase
    - “Need by” date from installation requirements
    - Difference (work days) determines construction schedule contingency
  - Total float held to end of project(minimal distributed contingency)
- Funding shifts between subprojects and Fiscal Years
- Increase scheduled installation time

- **Site Construction: hardstands, utility pads, gas shed,...**
- **Mezzanine construction: walls, roofing, flooring, finishes (painting, carpeting), computer floor for counting room**
- **Elevators**
- **Cooling and HVAC: Chillers, Computer room cooling, Natural Gas**
- **Plumbing**
- **Electrical: lighting, substations, emergency generator, feeders**
- **Fire Detection**
- **This is conventional work that Fermilab knows well**

- Begin Conceptual Design in FY04
  - Increases bid package schedule contingency by reducing Title 2 engineering design cycle
    - Phase 1 construction scheduled to begin late January '05
    - Need to do design work and make procurement by then
  - Reduces FY05 C0 expense ~\$250K
- Critical path is the work needed for beneficial Occupancy (Phase 1 construction)
  - Ready by Dec. 2005
  - Needed by July 2006
  - 157 days of schedule contingency
- **Only schedule concern is delay in starting**
- Tom Lackowski has details in breakout session

- Unstaged - Critical activity (pixels, Stage 1 trigger, EMCAL)
- Use modified LHC quadrupoles
  - Run at 4.5° K rather than the design 1.9° K.
  - The cryostat will be reduced in diameter so the magnet doesn't intersect the tunnel floor.
  - Fabricate 10 quadrupoles and spool pieces + spares
- Long lead-time procurements
  - Superconducting wire
  - Corrector magnets
  - High current leads



- Critical path - Spool production
  - 9 months between “Ready by” and “Need by” dates
    - Gained 5 months by defining when needed more carefully
    - Net gain of 4 months in reworking task durations
      - Some shorter, some longer, all based on actual experience
- Cost decreased \$150K
- Profile changes from CD-1 review

Fiscal Year	2005	2006	2007	2008	2009	2010
Base M&S (\$K)	-10	+746	-747	-346	+285	+86
Labor (FTE)	+0.5	+0.7	-0.8	-1.8	-4.5	+6.1

- Need to make procurements by Jan. 2005 in current schedule
  - PO for Superconducting wire
  - Cold mass components earlier, but might be able to shift



- Unstaged system, which includes:
  - Dipole analysis magnet
  - 2 toroid assemblies
  - beampipe
- Subproject scheduled completions are:
  - Magnets installed by Feb. 08 – 145 days float
  - Beam pipe installed in Summer 2009 – 311 days float
- Cost change
  - +110K
- Minimal schedule risk here

- Unstaged – Critical activity
- Technically challenging system
  - 23 Million Pixels
  - Bump bonding
  - Motion control
  - Large Vacuum system
- External vendors required for
  - Sensors
  - Pixel readout ASIC's
  - Bump bonding
  - HDI's
- Followed by extensive construction at SiDet



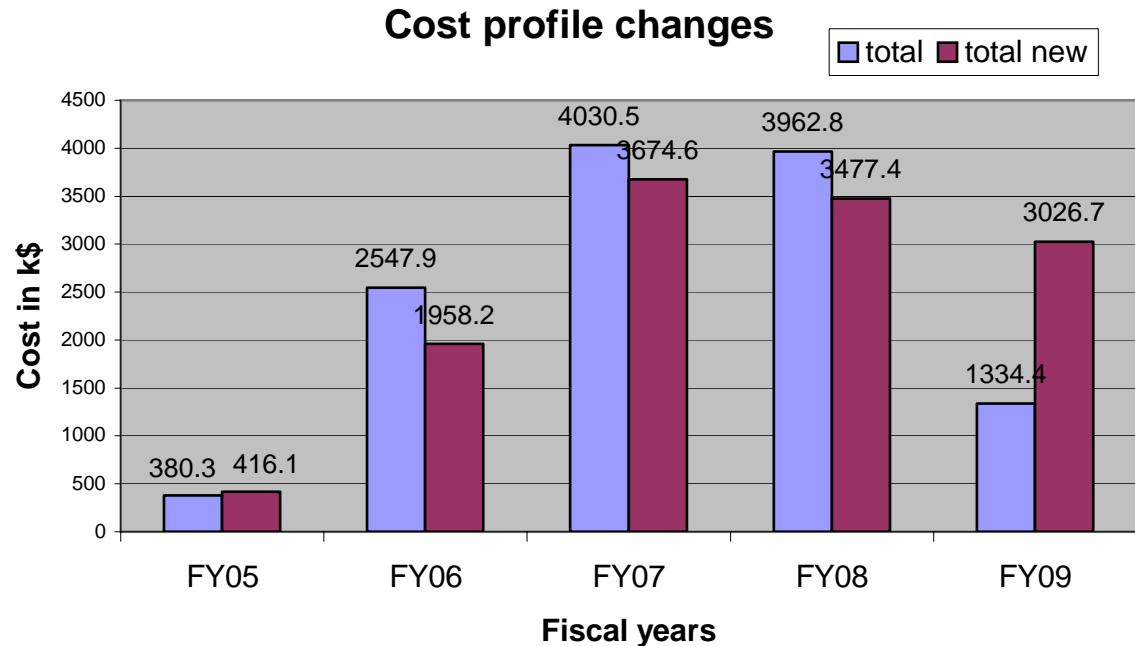
- CD-1 schedule contingency was 63 days
- Plan revisions enlarge that to 229 days, accomplished by:
  - Substantial changes to funding profile
    - Advanced purchase schedule by 1 FY for some items
  - Combined preproduction and production orders for sensors, readout chips, and HDI's
  - Added 3 months to hybridization task
- Sensor order (Dec. 2004) can be delayed until March 1, 2005 in the current schedule
- Contingency analysis done by increasing critical task durations by ~30%
  - Most have no effect on “ready by” date
  - 100 day delay in Hybridization results in ~50 day reduction in overall schedule contingency
- Total cost unchanged – \$20.65M

- Staged Detector – Gas first, then liquid
- CD-1 review had no major issues with RICH
- Schedule contingency was 78 days (MAPMT electronics, Gas detector)
- Contingency is now 197 days (liquid recirculation)
  - Low schedule risk
- Delay in PMT acquisition to shift funds to electronics
- No change in cost
- Need to purchase tank structural material in FY05

- Staged - Critical activity
- Lead Tungstate calorimeter
  - 10k crystals needed
  - Rad hard
  - Based on CMS experience
  - Readout using PMT's and QIE ASIC
- CD-1 schedule of crystal delivery was judged to have excessive schedule risk
  - Delays in CMS acquisition
  - Lengthy production cycle
- Increase schedule contingency:
  - Roll in 50% loaded EMCAL structure in Summer 2009
  - Insert remaining 50% in Summer 2010
  - Shifts funding to 2009 also – helps cost profile

- Have always pursued multiple vendor strategy
  - 50% in China and 50% in Russia(two vendors there)
- Schedule risk due to competition for crystals with CMS?
  - Default plan assumes
    - Chinese crystals begin production 2006, for a long duration
    - Russian crystals begin at higher rate upon completion of CMS production in 2007
  - Discussion with CMS
    - Minimal impact on final delivery dates for BTeV
    - Might result in higher production rates and a later start
- For staged detector
  - 50% loaded structure ready Summer 2008 - 229 days contingency
  - 2nd 50% ready Sept. 24, 2009 - 191 days contingency

- Overall cost has increased \$400k
  - Accelerate Chinese crystals
- Staging pushes costs into 2009
- Need to begin purchasing FE electronics(QIE ASIC) by May 2005 in current schedule





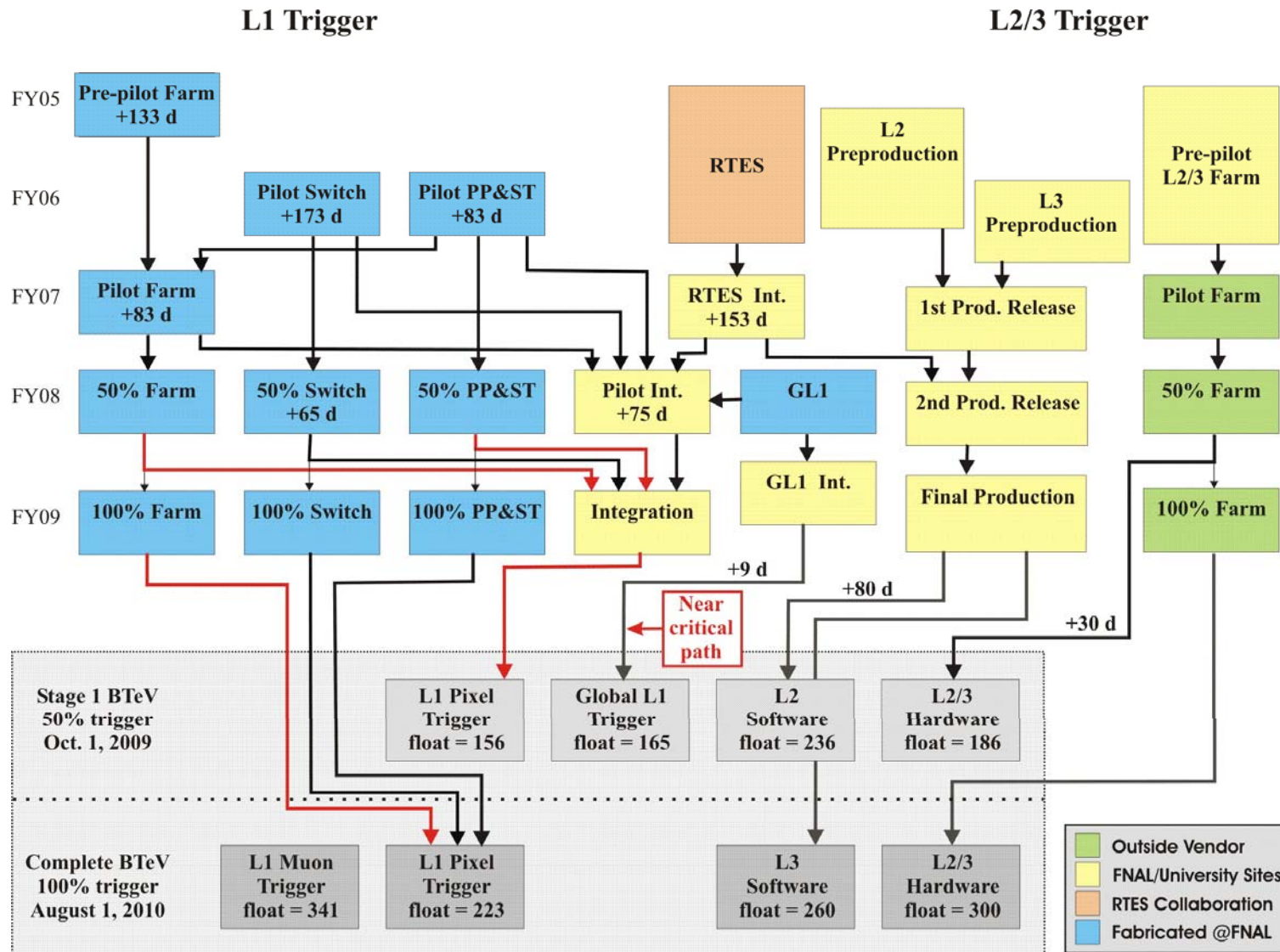
- Staged Detector
- Design is robust and simple
  - 38k 3/8" SS proportional tubes
  - Modular construction
  - Common FE electronics w/ straws
- Will install stations 2 and 3 (behind toroid) in stage 1
- Base cost changed by \$412K from CD-1
  - Added QA tech + test stand
- Schedule contingency > 450 days for all 3 stations
- Scheduled to begin parts production in January '05
  - Delays in parts production and tube delivery, etc. introduce some delay in the "ready by" dates
  - Low overall schedule risk
- Staging limits schedule risk in first installation period

- Part of staged detector
- 7 independent systems makes staging straightforward
  - Stage stations that do not require removal of ones installed earlier
  - #1,2,5,6,7 – Still provides excellent tracking in early running
- CD-1 schedule contingency presented was 46 days
- Current contingency is 218 days
  - “Need by” dates in two stages
  - Incorrect linking of predecessor in chamber construction start
  - 2 assembly lines -> 3
- Most stations have much greater contingency(>300 days)
- Schedules are robust against anticipated delays
- Need to begin final design work by March 2005 in current schedule
- Staging limits schedule risk in first installation period

- Cost increased \$285K
  - +\$100K from updated quote on straw cost
  - +\$180K additional staging fixtures
    - Reduce installation time from 1 week/station to 2 days/station

- Staged detector
- No production schedule issues
- CD-1 review had no cost or schedule issues
- INFN will provide funding for this subproject
- Current contingency is 186 days
  - Still limited by US funding start date
- Staging limits schedule risk in first installation period

- Staged system - Critical activity
- Sophisticated system consists of:
  - Displaced Vertex trigger
  - Muon trigger
  - Global Level 1
  - Trigger management, switches, etc.
- CD-1 schedule contingency was less than 30 days in more than one place
- Greater schedule contingency needed:
  - Staging
  - Funding profile advanced
- Current schedule contingency is 156 days



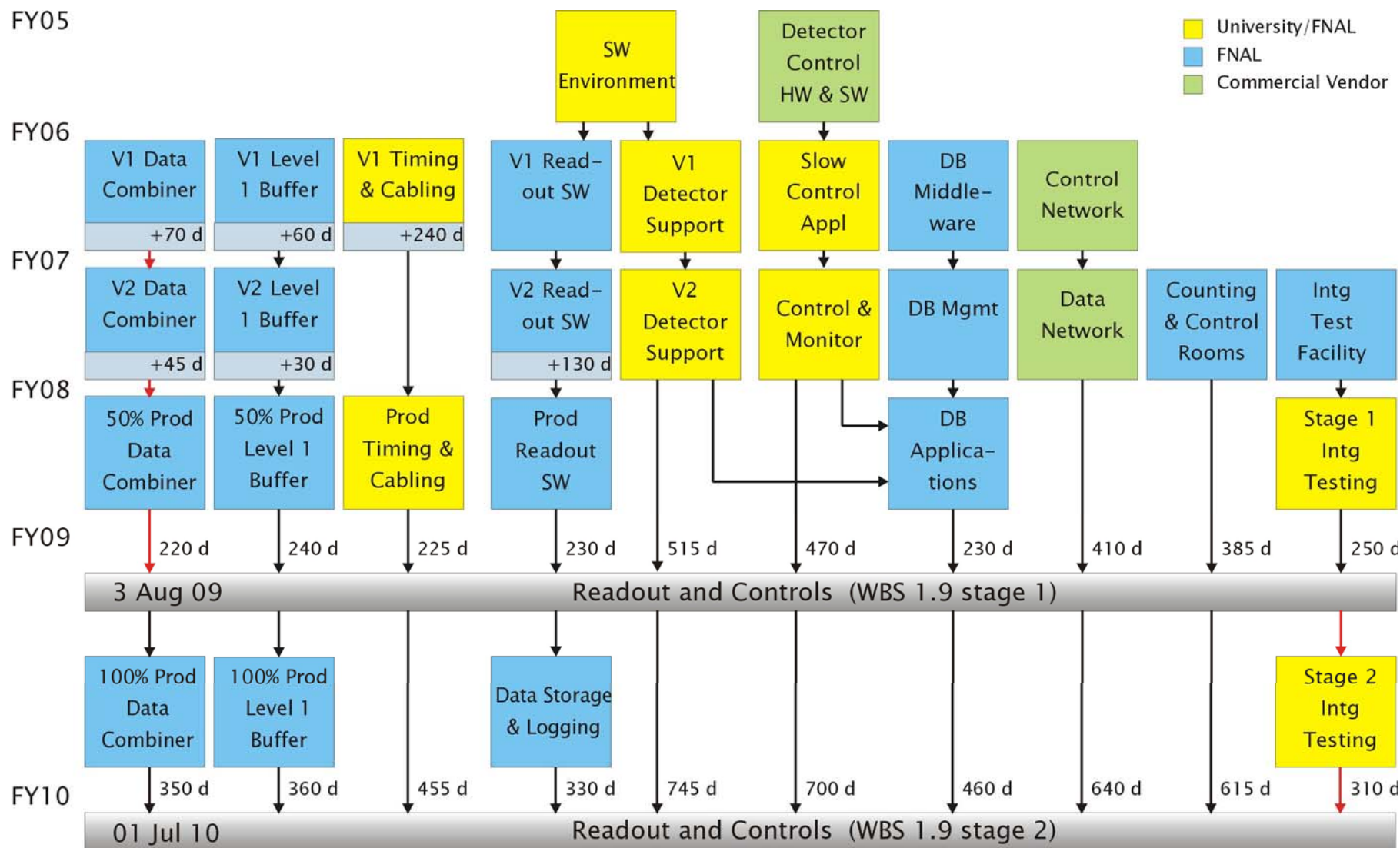
	<b>FY05</b>	<b>FY06</b>	<b>FY07</b>	<b>FY08</b>	<b>FY09</b>	<b>Total</b>
CD-1	637K	2,150K	2,651K	4,506K	7,103K	17,046K
Staged	783K	2,571K	2,230K	6,618K	4,972K	17,175K
Net Change	146K	421K	(421K)	2,112K	(2,131K)	129K

- To achieve greater schedule contingency the funding had to be accelerated
- Need to begin procurement of pre-pilot farm by Feb 2005 in current schedule
- Effect in delays at critical points can be seen in previous slide

- Staged System
- Composed of:
  - Readout electronics
  - DAQ software
  - Detector control system
  - Databases
  - Control and Data network
- CD-1 showed 29 days float on Readout Electronics
- Greater schedule contingency needed
  - Staged installation - 50% in 1<sup>st</sup> shutdown, remainder in 2<sup>nd</sup>
  - Advanced funding profile
- Current schedule contingency is 220 days



# WBS 1.9 Project Flow Diagram



	<b>FY05</b>	<b>FY06</b>	<b>FY07</b>	<b>FY08</b>	<b>FY09+10</b>	<b>Total</b>
CD-1	393K	2,669K	3,571K	5,090K	4,614K	16337K
Staged	436K	2,662K	3,624K	5,955K	3,707K	16384K
Net Change	43K	(7K)	53K	865K	(907K)	+47K

- To achieve greater schedule contingency the funding had to be accelerated
- Production purchases come later in FY05 in current schedule for this group
- Effect in delays at critical points can be seen in previous slide
  - Still a number of tasks very close to critical path

- The CD-1 committee recommended longer installation schedule
  - New staged schedule 17 weeks -> 30 weeks
  - 50% of EMCAL crystals installed in assembly hall
  - Staged tracking installation
  - Trigger and DAQ equipment installed in the Counting Room can be installed between two long shutdowns
  - Installation plans based on single shift 5-day/week operation
    - OT + Saturdays provide first line of schedule contingency
    - Go to double shifts if needed
  - Comparison - KTeV's installation task
    - Took 6 months
    - Should have many infrastructure tasks already completed
- Cost increased \$2.1M – Contingency increase to 75% and additional installation labor

- At CD-1 review - Early annual shutdown activities
  - Many tasks scheduled for the earliest possible shutdown
    - provided little float
    - most could be scheduled for the next shutdown
- Revised so:
  - “Need By” date is “latest point in the latest shutdown” that component must move into the Collision Hall
- Detailed flow and linkages need careful, methodical time
  - Subproject staging defined only recently
- BUT - Doubling installation time will guarantee successful installation
  - Now compares favorably to similar experiments

- Installation order(pre-2009):
  - South (un-instrumented) toroid
  - Vertex magnet
  - North toroid
  - RICH detector tank
- 2009 order;
  - ECAL structure
  - North RICH MAPMT
  - Pixel tank
  - Forward tracking beam pipe
  - Forward tracking stations 1,2,5,6,7
  - South RICH MAPMT
- (quasi) independently
  - Muon stations 2,3
  - Trigger and DAQ

Have installation plans for all subprojects with time estimates for task durations.

Example:

5k crystals to install in 12 week shutdown. Can install 600/per week in single shift, 2 crews. Could install 7k crystals in 12 week shutdown – 40% contingency

- 2010 shutdown installation
  - Remaining two straw stations
  - 3 strip stations will be installed to complete the forward tracking.
  - Muon station 1
  - Last three RICH PMT arrays
  - 2<sup>nd</sup> 50% of crystals loaded into EMCAL structure.
  - 2<sup>nd</sup> half of Trigger and DAQ will be installed
- Have retained 2-4 weeks contingency at the end of each scheduled shutdown activity through 2010

- There were many good schedule points made in Lehman review
- Our scheduling is strengthened by them
- To be credible:
  - Substantial funding was shifted
    - Between projects
    - Into different Fiscal Years
    - Additional external funding
  - Staging allows efficient usage of FY09 funds
    - Crystals, Trigger, DAQ
  - Correct calculation of end points and additional careful work on the schedule linkages, etc.

- Shortest Schedule contingencies
  - Toroids, dipole – 145 Days
  - Stage 1 Trigger - 156 days
  - C0 Phase 1 – 157 days
  - IR Spools – 175 days
  - Stage 2 EMCAL – 191 days
  - RICH liquid recirculation – 197 days
  - Stage 1 DAQ – 220 days
  - Pixel Detector – 229 days
  
- IR Spools and Pixel detector determine if we can run the experiment.